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STUDIES OF MICROPTERUS SPECIES IN TWO CLARK FORK RIVER HYDROELECTRIC IMPOUNDMENTS IN WESTERN MONTANA

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by

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Abstract

The status of introduced smallmouth bass (Micropterus dolomieri) and resident largemouth bass (Micropterus salmoides) populations were studied on two Clark Fork River hydroelectric projects during the summer of 1984. Smallmouth bass primarily utilized habitats characterized by hard substrates (usually in close proximity to deep water) and were distributed throughout Noxon Rapids Reservoir. Growth appeared to be quite rapid when compared to other U.S. waters, with mean lengths of 137mm (1-year) and 197mm (2-year) . Ninety-eight percent of the smallmouth collected were two years of age and hence from the 1982 plant. Redside shiners (Richardsonius balteatus) were the predominant food item in the smallmouth bass diet. Largemouth bass were distributed throughout Noxon Rapids Reservoir, but were somewhat confined in Cabinet Gorge. In both reservoirs, largemouth utilized waters in or near littoral areas. Growth of largemouth appeared to be reduced when compared to that of other U.S. water bodies. Age class 4 made up 39% of the largemouth bass sampled and was the strongest age class.

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Introduction

The Washington Water Power Company owns and operates the Noxon Rapids and Cabinet Gorge hydroelectric projects on the Clark Fork River in Western Montana (Figure 1). Noxon Rapids Reservoir is approximately 38 miles in length and has a total and active storage capacity of 495,000 and 230,700 acre-feet, respectively. The surface area of the reservoir at maximum pool is 7,940 acres. The reservoir provides seasonal water storage with up to a 36 foot vertical drawdown capacity (Woodworth 1985).

Cabinet Gorge Reservoir is approximately 20 miles in length and has a total and active storage capacity of 104,500 and 42,780 acre-feet, respectively. At full pool, the surface area of the reservoir is 3,200 acres. The reservoir operates in a relatively stable manner as a run-of-river hydroelectric project. The maximum possible drawdown of 15 feet occurs infrequently (Woodworth 1985).

Past studies have indicated that non-game fish species have dominated the biomass of both reservoirs and that game fish are present in insufficient numbers to promote a viable sport fishery in other than isolated areas (Gaffney 1956; Huston 1965; Shrier 1983). The primary reason for the success of non-game species in the system is their adaptability to the particular conditions present in the reservoirs. Ideally, one would want to find a game fish species which could do well under these same "run-of-the-river" conditions. For this reason, smallmouth bass were introduced into Noxon Rapids Reservoir in the summer of 1982 and 1983. Approximately 100,000 smallmouth bass were released as fry ($\simeq$ 1") in mid-July of 1982 and approximately 50,000 fry were released in 1983. Both years the smallmouth bass fry were released at the Flat Iron boat landing on the upper section of the reservoir.

The primary objective of this study was to determine the status of the introduced smallmouth bass as well as the resident largemouth bass populations. Data was collected on distribution, habitat preferences, age and growth, and food habits.

Methods

The study period lasted from 22 May to 24 August during the summer of 1984. Since Noxon Rapids Reservoir was of primary concern, only two weeks in the middle of August were spent sampling Cabinet Gorge Reservoir, with the remainder of the effort being spent on Noxon Rapids. Of the sampling effort of Noxon Rapids, approximately 70% was spent on the lower section, with the remainder of the effort being concentrated at Finley Flats and Sites A and B (Figure 2).

Hook and line techniques were the primary methods employed (approximately 90% of the effort) to collect bass from Noxon Rapids and Cabinet Gorge Reservoirs. Other methods used to a lesser extent included: beach seining with a 200' x 8', 3/4" bar mesh bag seine and nighttime electrofishing from a boat driven parallel to the shoreline; snorkeling methods were used on a qualitative basis only.

Fish collected with all gear types were identified, measured to total length (inches) and weighed (lbs). All measurements were later converted to metric units. Most of the bass collected were released, however, a small percentage were sacrificed so stomach contents and reproductive organs could be collected.

Stomach contents (and reproductive organs) were preserved in formaldihyde and later examined in the laboratory. The contents of each stomach sample were sorted, enumerated and identified. Mean counts of various food items were calculated and presented as percent numerical occurence. Reproductive organs were examined to determine spawning condition.

Scales were consistently removed from the same location on the left side of the bass, at the posterior extension of the pectoral fin below the lateral line. Scales (2 to 5 per fish) were pressed onto acetate slides using a heated hydraulic press by Montana Department of Fish, Wildlife and Parks personnel. Scale projection was used to magnify and examine the scales. A representative scale from each slide was measured (mm) from the focus to the anterior scale margin and to each annulus along the vertical axis (Bennett et. al. 1983). Regenerated or damaged scales were discarded and not used in the analysis.

Back-calculated lengths at age were calculated using a model based on a linear relationship between scale length and body length. Several models were tried, however, the linear model accounted for the most variation (highest r^2 valve). The model used was:

$$BL = B_0 + B_1 (SL)$$

Where:

BL = body length (mm)
SL = scale length (mm)
B_0 = constant (y-intercept)
B_1 = constant (slope)

Condition factors were calculated using the following equation:

$$K = W/L^3 \times 10$$

Where:

K = body condition
W = wet weight (g)
L = total length (mm)

Benthic samples were collected at four of Shrier's (1983) Noxon Rapids Reservoir limnological sampling stations which included:

1) Robinson's Rock - between the two islands;

2) Marten Creek Bay - approximately 5m east of the bridge crossing Marten Creek Bay;

3) Trout Creek - approximately 15m directly out from the North Shore campground boat landing; and,

4) Vermilion River Bay - approximately 5m north of the road crossing the bay.

An Ekman dredge ($\sim$225 cm^2) was used to collect benthos from 2, 10, and 20m depths at the Robinson's Rock and Trout Creek Stations; and from depths of approximately 3 and 5.5m at Marten Creek Bay and Vermilion River Bay Stations, respectively. Two samples were collected at each station during late summer. All samples were washed through a No. 35 standard sieve and preserved in formaldihyde for later examination in the laboratory. Preserved organisms were sorted, enumerated (average nos./m^2) and identified to the family level.

Smallmouth bass were collected at five sites (A-E) throughout Noxon Rapids Reservoir. Sites A and B were located on the upper section of the reservoir, whereas Sites C, D and E were located in the lower section. The location and general description of each site is listed below:

Site A: Mosquito Creek mouth - predominantly a cobble and boulder substrate intermixed with some silt; overhanging riparian cover; and depths ranging between 0.15 and 1.5m.

Site B: Small slough (on the north side of the river) approximately 1/3 of a mile (0.54km) upriver from the mouth of Graves Creek - predominantly a mud and silt substrate; riparian cover consisted of primarily cattails and depths ranging between 0.1 and 0.23m in the back portion of the slough, and depths ranging between 0.6 and 1.2m in the channel entering the slough.

Site C: Back end of small bay (south side of river) approximately 3 miles (4.8km) downriver from Marten Creek Bay - small inflow entering back of bay; east side of bay predominantly sand substrate; west side of bay predominantly rock walls; and, the bottom rapidly dropped off to a depth in excess of 5m.

Site D: Vicinity of Marten Creek Bridge - predominantly rip-rap and piling cover; and, depths ranging between 3 and 4m.

Site E: Vicinity of Trout Creek Bridge (in the back of the bay) - predominantly rip-rap and piling cover; and, depths ranging between 2.5 and 3.5m.

Results

Distribution and Habitat Preferences

Smallmouth bass were observed throughout Noxon Rapids Reservoir, however, they were only collected at five sites (Figure 2). Bio-data from 56 smallmouth bass were collected during the three month study period. The greatest concentrations of smallmouth were observed at sites B and A, respectively. Ninety-three percent of all the smallmouth bass collected were collected at these sites. Both sites were approximately four river miles downriver from the introduction point, with site B being slightly upriver of site A. The furthest downriver collection site was site C, which was approximately 30.5 miles from the introduction point.

Smallmouth bass from Noxon Rapids Reservoir were found in areas ranging from shallow, warm backwaters (site B) to relatively deep, cool water channels (sites D and E). In many cases, smallmouth bass shared the same habitats with largemouth bass and in a few instances were even observed in the same schools.

Largemouth bass were observed and/or collected throughout Noxon Rapids Reservoir, however, they were mostly concentrated in the bays and backwaters of the lower section (Figure 2). The greatest concentrations were observed in North Shore Slough, Trout Creek Bay. Marten Creek Bay, the slough 2.5 miles downriver from Marten Creek Bay and Finley Flats Slough (the only area on the upper section where largemouth were found to be concentrated). Bio-data from 113 largemouth bass were collected from Noxon Rapids during the study period.

Largemouth bass were only observed and/or collected in Cabinet Gorge Reservoir between the Noxon Bridge and Bull River Bay (Figure 3), with the greatest concentrations being observed in Hereford Slough, Noxon Bay and Noxon Slough. Only eight largemouth were collected from Cabinet Gorge during the abbreviated two-week sampling effort.

Largemouth bass in both reservoirs were primarily collected in or near shallow bays or backwaters. Some were observed in deeper waters, however, littoral areas were always in close proximity. In all cases, largemouth bass appeared to be very structurally orientated; whether the structure was dense macrophyte mats in the backwaters (i.e.,

Finley Flats) or pilings and stumps in deeper channels (i.e., Marten Creek Bridge).

Length/Age Data

Growth of smallmouth bass in Noxon Rapids Reservoir was comparable to that of other U.S. water bodies (Table 1). Length/age data was calculated using the following linear equation:

$$BL = 78.8 + 0.6868 (SL)$$

Where:

BL = body length
SL = scale length

This equation accounted for the most variation ($r^2 = 0.77$).

Figure 5 shows the size classes of smallmouth bass collected from Noxon Rapids Reservoir prior to annulus formation in July, which was estimated by comparing growth over time. Sixty-three percent of the individuals collected were between 180 and 210mm. Except for one one-year old fish, all the smallmouth bass collected were two years of age and hence from the 1982 introduction.

The overall average size of smallmouth bass collected from Noxon Rapids Reservoir was 192mm (n=56), however, there appeared to be a difference in the average size of individuals collected from the lower and upper sections of the reservoir. In upper reservoir collection sites, smallmouth bass averaged 177mm (n=8) during the month of August, whereas in lower reservoir collection sites, smallmouth bass averaged 260mm (n=3) Sizes ranged from 132 to 269mm and the average condition factor was calculated to be 1.42 for all the smallmouth bass collected.

Growth of largemouth bass in Noxon Rapids Reservoir was relatively slow when compared to other U.S. water bodies (Table 2), however, growth was similar to that of previous studies on the same water body (Figure 7). Growth of largemouth bass collected in Cabinet Gorge Reservoir was slightly less than that experienced by Noxon Rapids Reservoir largemouth bass (Table 2). Length/age data was calculated using the following equation:

$$BL = 4.62 + 0.00325 (SL)$$

Where:

BL = body length
SL = scale length

This equation accounted for the most variation ($r^2 = 0.93$).

Figure 6 shows the size classes of largemouth bass collected from Noxon Rapids Reservoir prior to annulus formation, which was estimated to be in the beginning of July. Thirty-nine percent of the individuals collected were between 250 and 300mm; most of which were four years of age.

The average size of largemouth bass collected from Noxon Rapids Reservoir was 279mm (range 25-527mm) while the average size of largemouth bass collected from Cabinet Gorge Reservoir was only 253mm (range 193-307mm). The average condition factor for largemouth bass in Noxon Rapids was lower than that of Cabinet Gorge Reservoir; 1.44 and 1.53, respectively.

Spawning

Upon examining the reproductive organs of 21 smallmouth bass collected from Noxon Rapids Reservoir, it was evident that none were in a spawning condition. Periodic observations indicated that largemouth bass in the system spawned sometime during the last two weeks in June.

Food Habits

Figure 4 illustrates the numerical occurence of food items in the stomachs of 13 smallmouth bass collected from Noxon Rapids Reservoir. Diets of smallmouth bass collected from the upper section of the reservoir consisted primarily of redside shiners and to a lesser extent, aquatic insects. Diets of smallmouth bass collected from the lower section consisted primarily of peamouth (Mylocheilus caurinus) and to a lesser extent, aquatic insects and crayfish. Collectively, redside shiners were the most predominant food item in smallmouth bass stomachs.

No quantitative data was collected on the food habits of largemouth bass, however, a qualitative examination of 23 stomachs from desicated individuals collected from Trout Creek Slough indicated that small pumpkinseeds (Lepemis gibbosus) and crayfish made up the majority of the diet. However, these largemouth bass were stranded in pocket waters, along with large numbers of prey species, so their feeding habits might have been markedly altered.

Benthics

Average numbers (per m^2) of benthic insects collected at various locations in Noxon Rapids Reservoir are located in Table 3. Chironomids were the dominant insect group, with the greatest concentration being collected at the Robinson's Rock 2m station. When chironomid numbers were compared to that of Shrier's (1983) data, substantial declines at the Trout Creek 10 and 20m stations were observed while a substantial increase was observed at the Robinson's Rock 2m station.

Other non-insect benthos, such as oligochaets and gammarids were collected, however, only gammarids were quantified because loose seals on the collecting jars containing the oligochaet samples allowed the preservative fluid to evaporate which lead to the desication of all the organisms. Fourty-three and 22 gammarids (per m^2) were present at the Robinson's Rock 2 and 10m stations, respectively. Identical concentrations of gammarids were also found at the Trout Creek 2 and 10m stations.

Discussion

Smallmouth bass in Noxon Rapids Reservoir appear to have distributed themselves over the entire length of the reservoir since their introduction in 1982. Their distribution, as illustrated on Figure 2, should be considered as a minimum estimate only since it was impossible for one person to efficiently sample all the possible areas. For the most part, the smallmouth bass have utilized what would be classified as "typical" smallmouth bass habitat; predominantly areas with cobble substrate and somewhat cooler water, usually in close proximity to deep water areas (Scott and Crossman 1973). However, the noteable exception was the abundance of smallmouth bass at site B, a small warmwater slough. Smallmouth bass were occasionally observed in other sloughs, however, never in the numbers observed at site B. I would think that the physical characteristics (silt bottom; shallow in depth; relatively warm water) of the slough would preclude any smallmouth bass from utilizing the area. Apparently, the large numbers of redside shiners (a preferred food item) present in the slough and refuge from main channel currents attracted the smallmouth bass to the area.

I would think that the warmer water (18° - 25°C; range during study period) of the upper reservoir collection sites would produce somewhat larger smallmouth bass when compared to the cooler water (13° - 20°C; range during study period) of the lower reservoir sites, however, this was not the case. Smallmouth bass collected from the lower reservoir sites averaged 85mm larger than the upper reservoir sites. Snorkeling observations reinforced this fact. The majority of the smallmouth bass sighted in the lower reservoir appeared to be in excess 229mm, especially at site E where schools of up to a dozen of these larger individuals were observed. Keating's (1970) study showed that 3+ age smallmouth bass grew faster in the colder waters of the lower Snake, Salmon and Clearwater Rivers than in the warmer waters of the upper Snake River. He felt that the reduced growth of smallmouth bass in the upper Snake River was the result of spacial restrictions in the preferred, shallower areas which forced the larger fish into a more competitive system in the deeper river channel. Since food items were overly abundant at both upper and lower reservoir sites, I hypothesize that the somewhat restricted physical characteristics of the upper reservoir sites resulted in reduced growth of the smallmouth utilizing those areas despite the warmer temperatures. However, other possible

factors for the apparent growth difference could be the small sample sizes involved or possibly the fact that the smaller individuals (1983 plants) may not have migrated to the lower reservoir sites.

Rapid growth experienced by most smallmouth bass in Noxon Rapids Reservoir is probably attributable to favorable water temperatures, abundant food resources and abundant suitable habitat. When compared to other Northwest water bodies, growth rates of smallmouth bass from Noxon Rapids Reservoir were better than the average. Exceptional first year growth experienced by Noxon Rapids Reservoir smallmouth bass was partially a result of the fish being raised under hatchery (optimal) conditions prior to being introduced into the system, as was the case observed by Marcuson (1981).

Since 98% of the smallmouth bass collected were two years of age and hence from the 1982 plant, it appeared that the smallmouth bass planted in 1983 possibly experienced significant mortality. However, the lack of 1983 smallmouth bass in samples might only indicate that those fish were utilizing other areas of the reservoir which were not sampled or that those smaller individuals were not susceptible to the hook and line techniques that were employed. Additional data which was analyzed by Joe Huston (MDFW&P personnel) indicated that two year-old fish comprised only 84% of the catch.

Smallmouth bass in Noxon Rapids Reservoir appeared to be very opportunistic in their feeding behavior; feeding on whatever food resource was most readily available, as was the case observed by Pflug and Pauley (1984). The dominance of forage fishes in the diets of smallmouth bass was indicative of the large numbers present in the reservoir. Pflug and Pauley (1984) in their study, found that two and three-year old smallmouth bass fed primarily on fish (specifically, Cottus sp.), while older fish fed primarily on crayfish.

Largemouth bass in Noxon Rapids Reservoir appear to be doing better than previous studies have indicated. Shrier's (1983) study suggested that largemouth bass in the reservoir were localized and hence could not provide a major game fishery. My findings indicate that although largemouth bass were more concentrated in the bays and backwaters, they were not restricted to them. I feel that not only the actual numbers, but the diversity of age classes observed in my study were indicative of a healthy population. Sampling methods prevented the effective collection of the youger age classes, however, snorkeling observations revealed large numbers of young-of-the-year largemouth fry. Similar observations were made in Cabinet Gorge Reservoir.

Unfavorable temperature regimes were a major influencing factor to the slow growth experienced by Noxon Rapids Reservoir largemouth bass. Largemouth bass in Cabinet Gorge Reservoir appeared to grow even slower, however, the probable cause for this apparent reduction in growth was the fact that the few largemouth bass collected were collected from Hereford Slough, which is fed by cold spring water.

Due to the small sample size of largemouth bass greater than 375mm, and the difficulty of reading scales of the older individuals, the predictive growth equation used was less accurate for age classes older than seven years. Similarly, the lack of small individuals (<150mm) in the sample also would make the predictive growth equation less accurate for the youngest age classes.

In reference to the majority of the data collected (both fisheries and benthics), it is important to note that the lack of sufficient replications prevent any statistical validation of the data; a fact that should be considered when evaluating the results of this study.

The establishment of a smallmouth bass fishery in conjunction with the established largemouth bass fishery in Noxon Rapids Reservoir should provide a viable sport fishery. However, in order to maintain that sport fishery, it is essential that those bass populations not be over-exploited.

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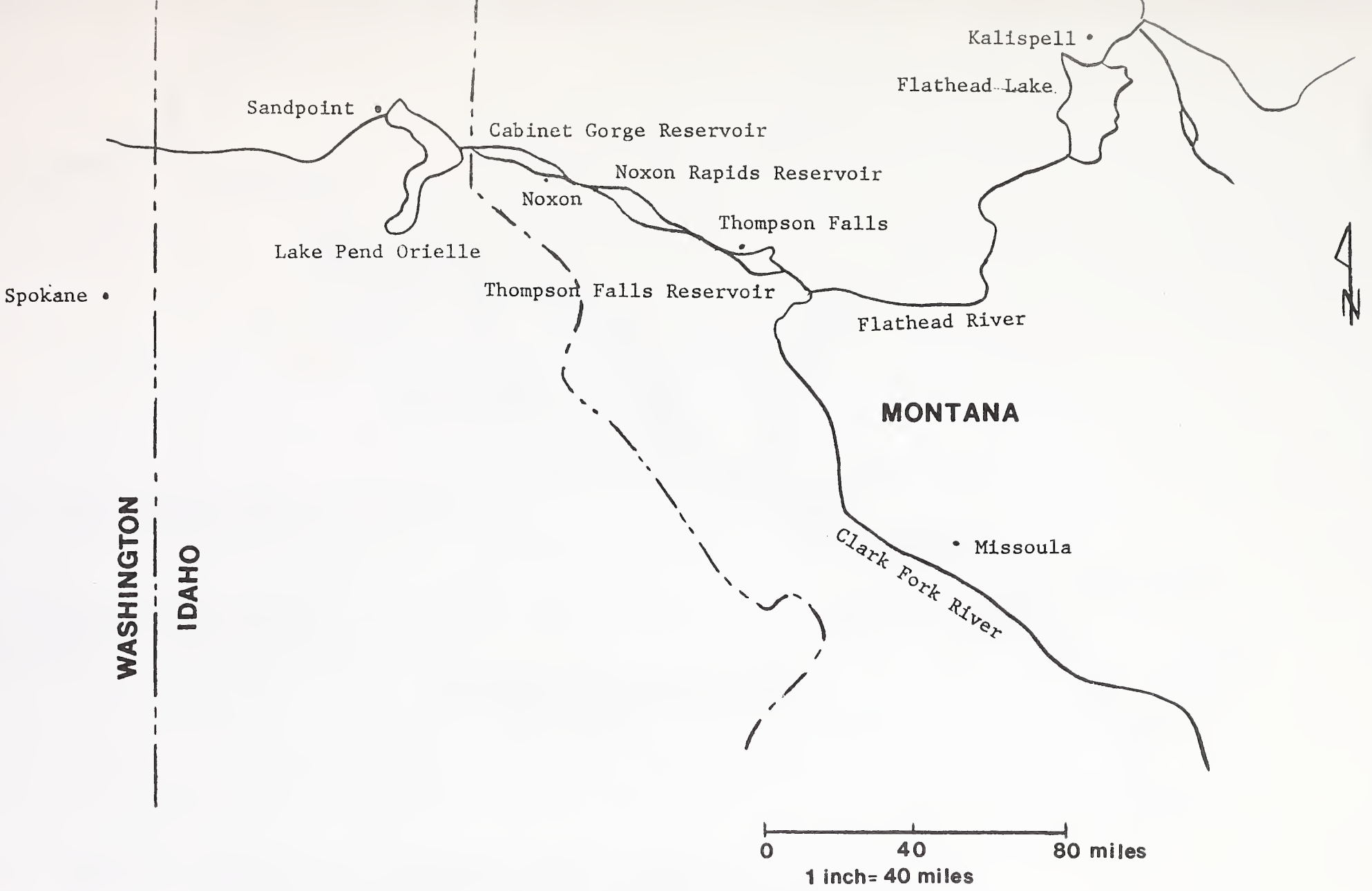

Figure 1. Location map of Cabinet Gorge and Noxon Rapids reservoirs on the Clark Fork River in western Montana (Huston 1965).

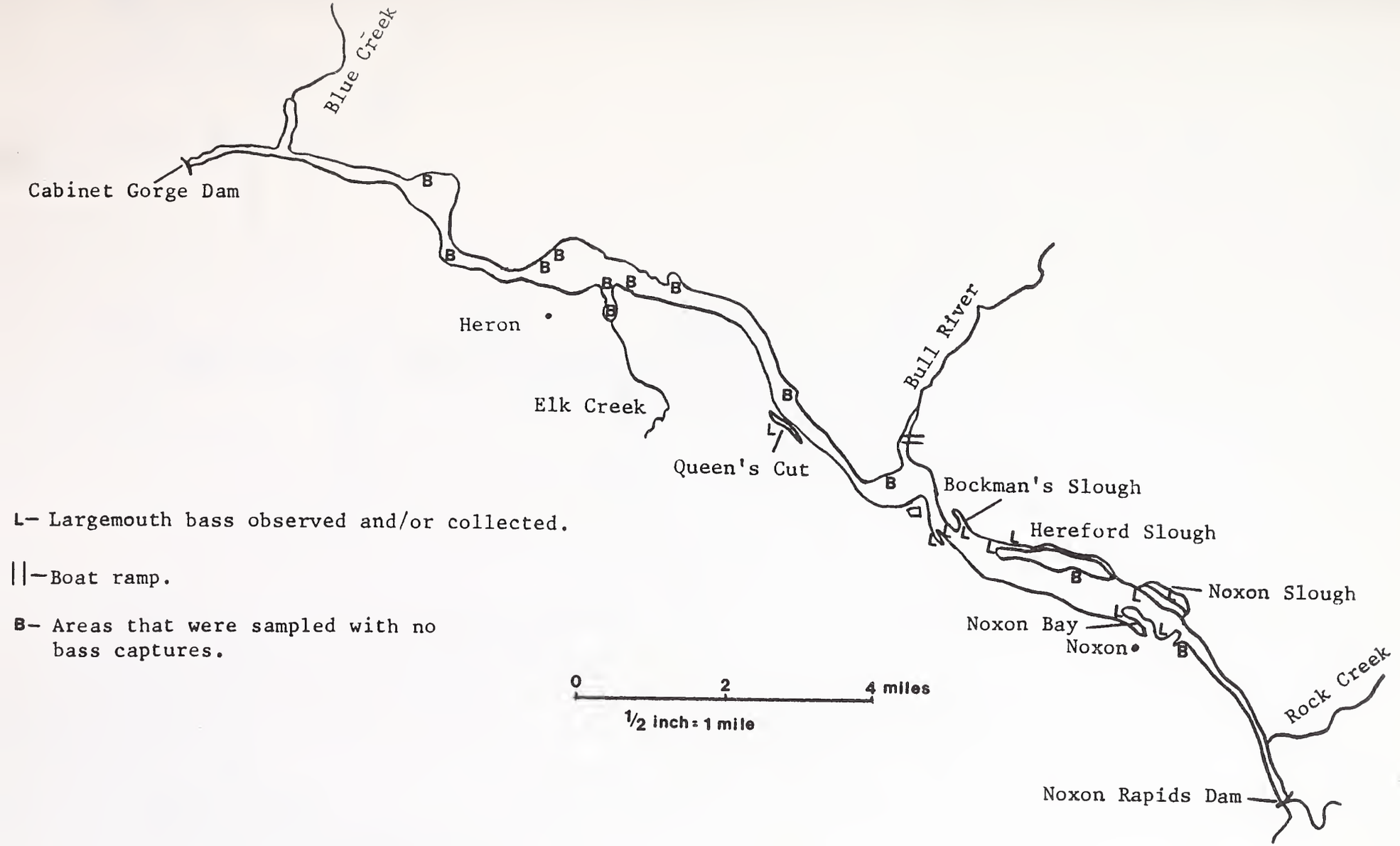

Figure 3. Distribution of largemouth bass in Cabinet Gorge reservoir, Montana in the summer of 1984. (Reproduced and modified, with permission, from Shrier 1983.)

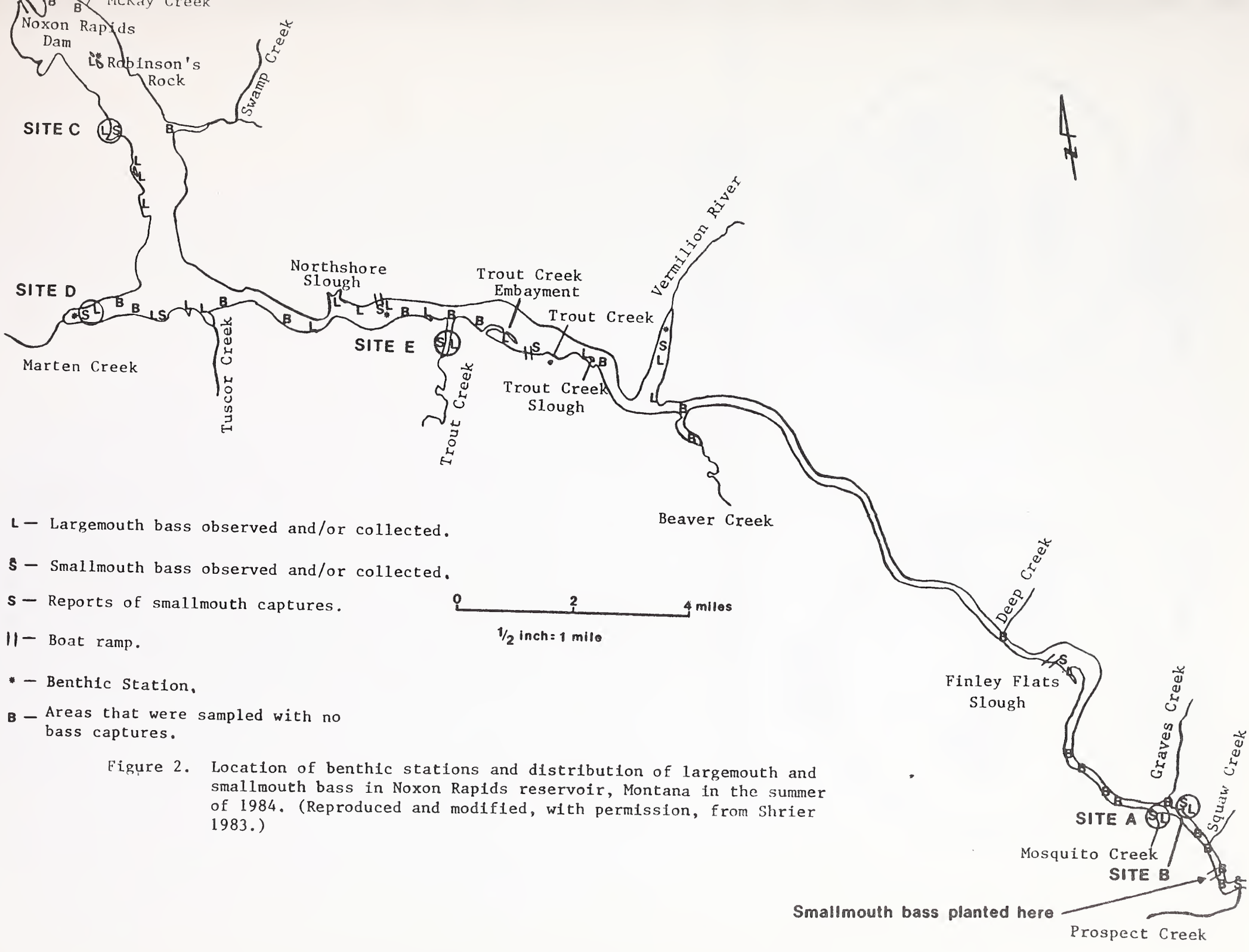

Figure 2. Location of benthic stations and distribution of largemouth and smallmouth bass in Noxon Rapids reservoir, Montana in the summer of 1984. (Reproduced and modified, with permission, from Shrier 1983.)

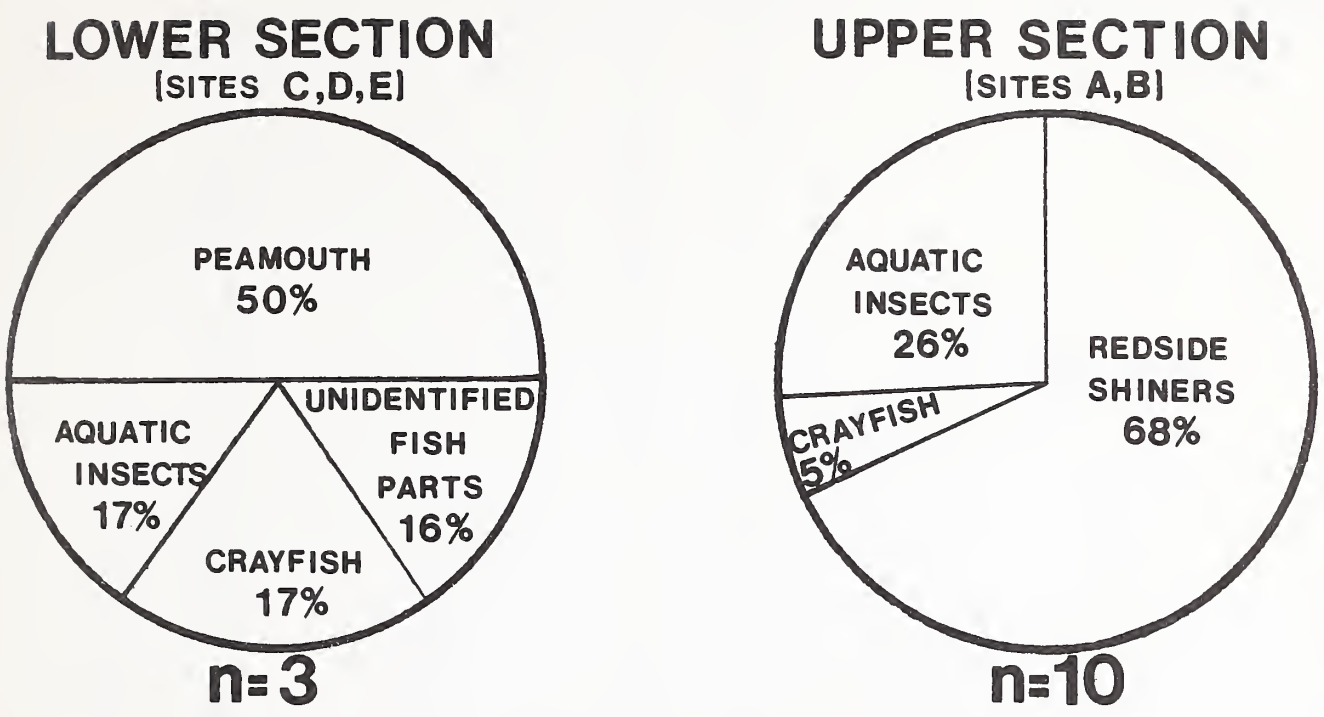

Figure 4. Numerical occurrence (%) of food items in the diet of smallmouth bass collected during the summer of 1984, from Noxon Rapids reservoir, Montana.

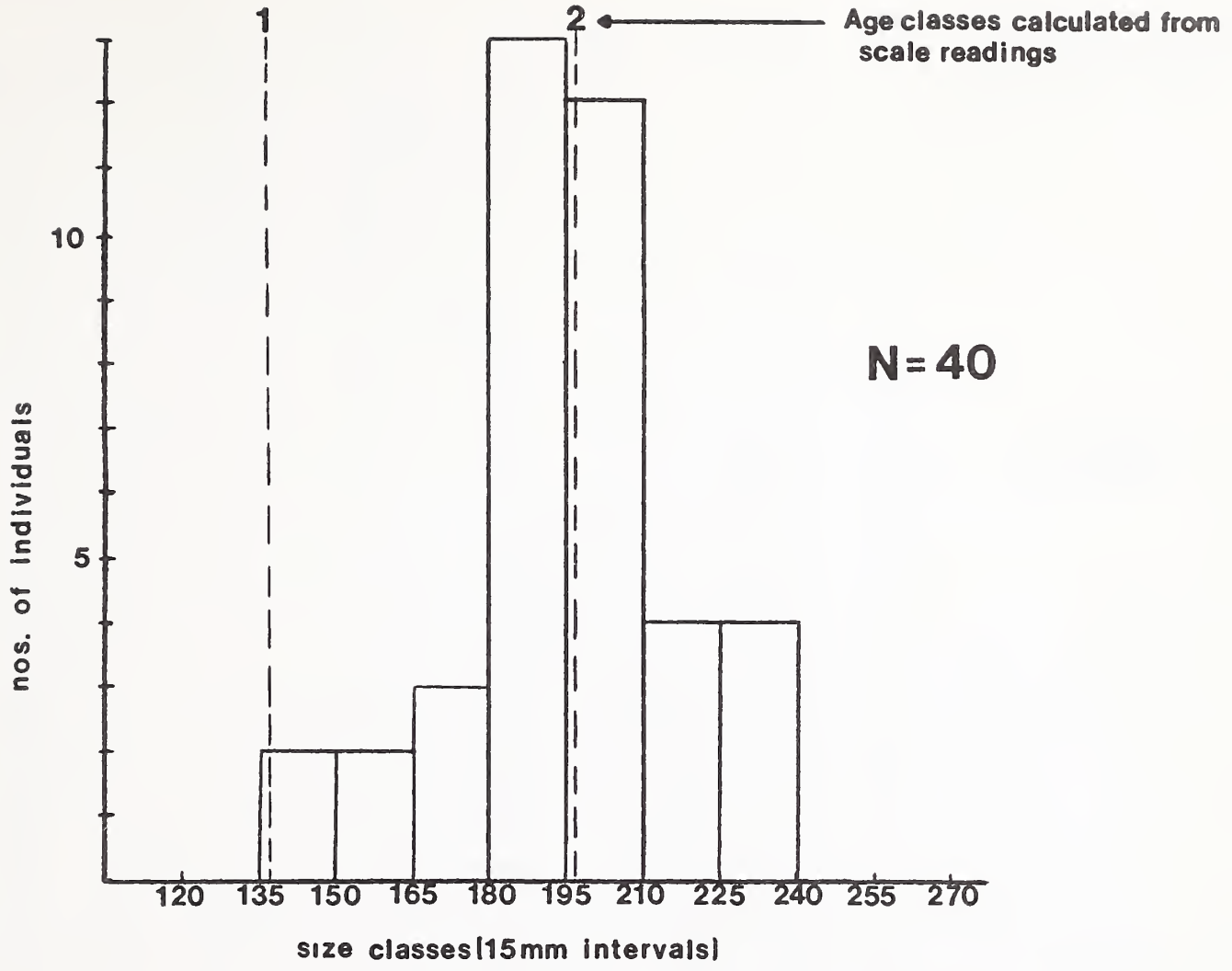

Figure 5. Size classes of smallmouth bass collected from Noxon Rapids reservoir, Montana between 18 June and 1 July 1984.

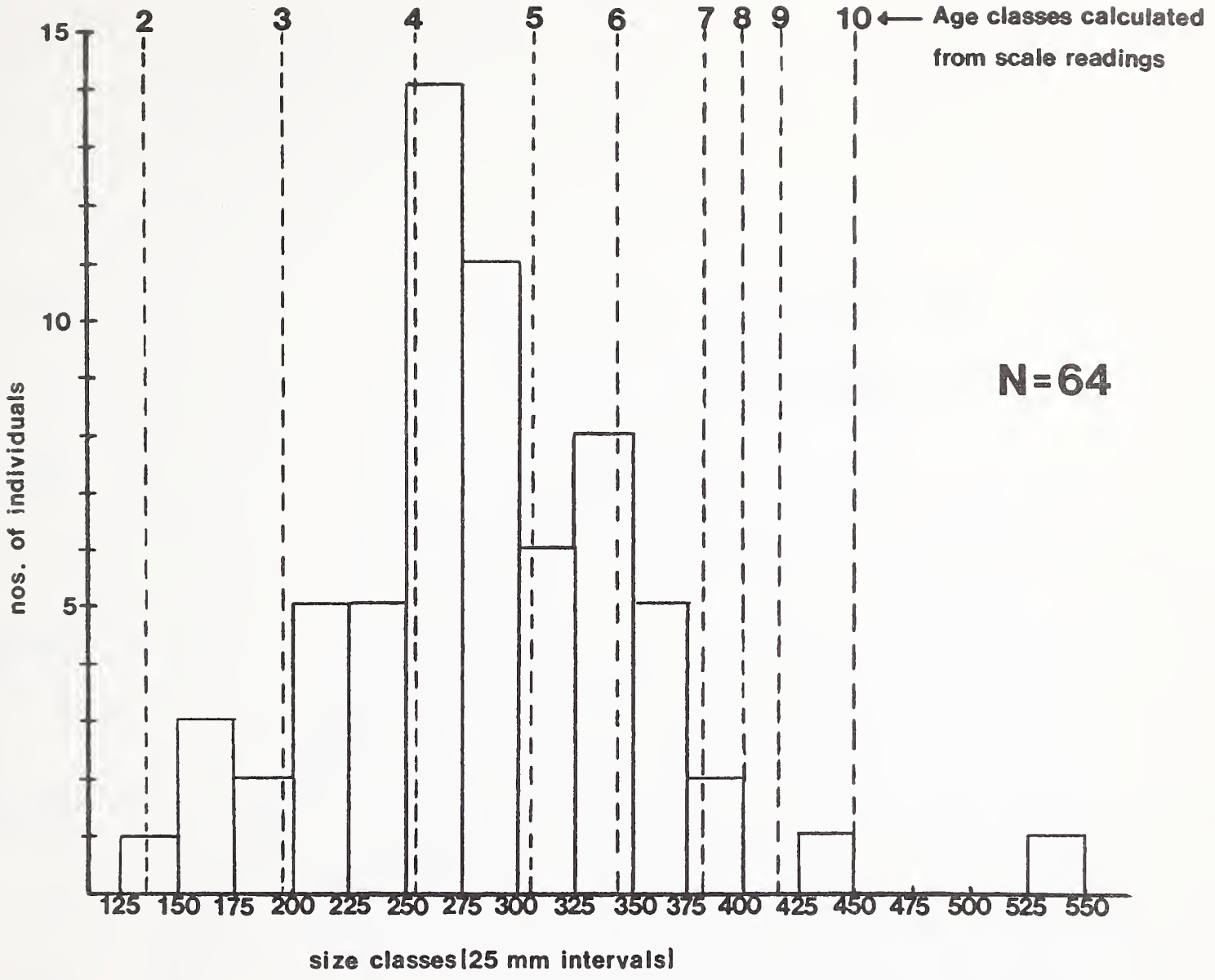

Figure 6. Size classes of largemouth bass collected from Noxon Rapids reservoir, Montana between 25 May and 1 July 1984.

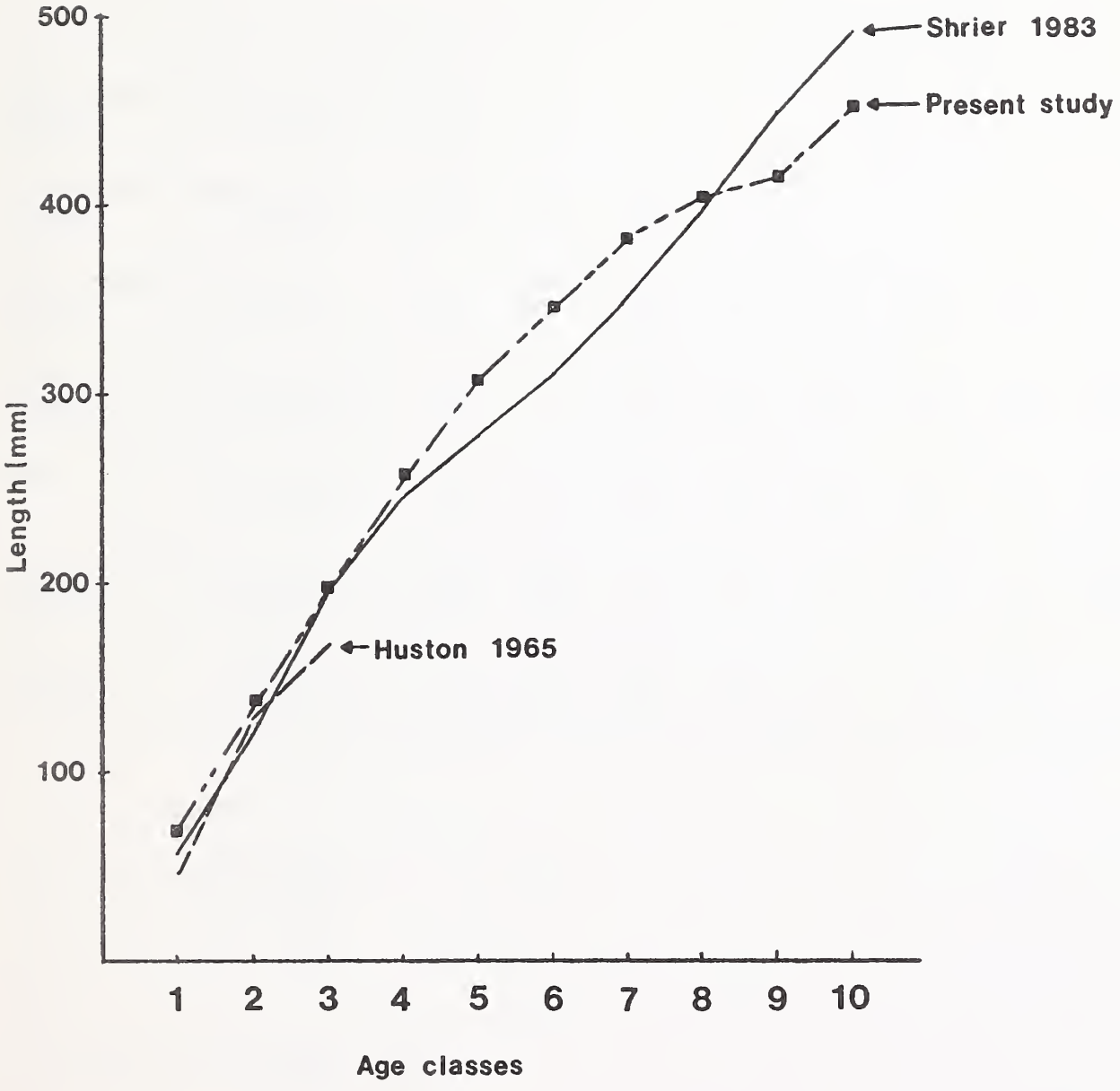

Figure 7. Calculated length-age data for largemouth bass collected from Noxon Rapids reservoir, Montana in the summer of 1984. (Length-age data also presented for two previous studies on the same water body.)

Table 1. Back-calculated mean lengths at annulus formation and growth increments (mm) for populations of smallmouth bass in Noxon Rapids reservoir, Montana (1984) and other U.S. waters.

Location		I	II	III	IV	V	VI	VII	VIII
Noxon Rapids Resv., MT.		137	197	-	-	-	-	-	-
(n=56)	Increment	137	60						
Musselshell River, MT.[1]		165	234	295	-	-	-	-	-
(n=42)	Increment	165	69	61					
Lake Sammamish, WA.[2]		101	185	260	314	357	383	414	-
(n=734)	Increment	101	84	75	54	43	26	31	
Little Goose Resv., WA.[3]		71	132	190	244	298	336	363	390
(n=494)	Increment	71	61	58	54	54	38	27	27
Lower Snake River, ID.[4]		84	145	206	239	267	292	310	322
	Increment	84	61	59	34	26	24	18	15
Red Cedar River, WI.[5]		100	190	274	329	383	407	424	444
(n=544)	Increment	100	90	84	55	54	24	17	20
Norris Resv., TN.[6]		117	259	358	411	444	457	472	-
(n=599)	Increment	117	142	99	53	33	13	15	

[1]Marcuson 1981

[2]Pflug and Pauley 1984

[3]Bennett et. al. 1983

[4]Keating 1970

[5]Paragamian and Coble 1975

[6]Stroud 1948

Table 2. Back-calculated mean lengths at annulus formation and growth increments (mm) for populations of largemouth bass in the Cabinet Gorge-Noxon Rapids reservoir system, Montana (1984) and other U.S. waters.

Location		I	II	III	IV	V	VI	VII	VIII	IX	X
Noxon Rapids Resv., MT.		68	134	196	253	306	343	381	401	414	451
(n=113)	Increment	68	66	62	57	53	37	38	20	13	37
Cabinet Gorge Resv., MT.		53	126	187	232	269	-	-	-	-	-
(n=8)	Increment	53	73	61	45	37					
Little Goose Resv., WA.[1]		85	147	232	292	357	418	443	-	-	-
(n=11)	Increment	85	62	85	60	65	61	25			
Fernan Lake, ID.[2]		64	130	189	238	303	343	370	398	418	470
(n=180)	Increment	64	66	59	49	65	40	27	28	20	52
Thompson Lake, ID.[2]		78	160	224	278	316	372	410	457	487	510
(n=190)	Increment	78	82	64	54	38	56	38	47	30	23
Medicine Lake, ID.[2]		88	156	225	289	378	408	453	465	496	520
(n=187)	Increment	88	68	69	64	89	30	45	12	31	24
Norris Resv., TN.[3]		175	277	373	409	445	490	528	-	-	-
	Increment	175	102	96	36	36	45	38			

[1] Bennett et. al. 1983

[2] Rieman 1982

[3] Stroud 1948

Table 3. Benthic insects (average numbers per square meter) collected during the summer of 1984, from various stations and depths in Noxon Rapids reservoir, Montana. (*- Ave. numbers of benthic insects/m^2, from Shrier 1983.)

	STATIONS							
	ROBINSON'S ROCK			TROUT CREEK			MARTEN CREEK BAY	VERMILION RIVER BAY
FAMILIES	2 m	10 m	20 m	2 m	10 m	20 m	~3 m	~5.5 m
CHIRONOMIDAE *	1141 (260)	194 (274)	108 (170)	517 (330)	65 (860)	87 (330)	388 (420)	689 (230)
CERATOPOGONIDAE	—	—	—	—	22	22	—	—
POLYCENTROPODIDAE	22	—	—	—	—	—	—	—
EPHEMERIDAE	—	22	—	—	—	—	—	—